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ASSESSMENT OF DoD JOB SKILL ENHANCEMENT PROGRAMS

J. D. Fletcher
James Bosco
Ruth Wienclaw
James Ashcraft
Gary Boycan

March 1991

Prepared for
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GLOSSARY

ACES	Army Continuing Education System
ARI	Army Research Institute for the Behavioral and Social Sciences
CAMIS	Computer Assisted Medical Interactive-Video System
CLEP	College Level Entrance Preparation
DITIS	Defense Instructional Technology Information System
DoD	Department of Defense
GED	General Education Development
GNP	Gross National Product
ICW	interactive courseware
JSEP	Job Skills Education Program
MOS	Military Occupational Specialty
NHSETC	Naval Health Services Education and Training Command
NIST	National Institute for Standards and Technology
OASD(FM&P)	Office of the Assistant Secretary of Defense (Force Management and Personnel
OASD(PA)	Office of the Assistant Secretary of Defense (Public Affairs)
PORTCO	Portable Courseware

SUMMARY

A. BACKGROUND

The National Defense Authorization Act for Fiscal Year 1991 directed the Secretary of Defense to provide an assessment of programs developed by the Department of Defense (DoD) that can be made available to civilian organizations to provide immediate support and assistance to upgrade skills for better civilian employment opportunities. This report was prepared in response to that direction.

B. CIVILIAN REQUIREMENT

There are skill deficiencies in the American workforce that can only be alleviated by training or retraining. The skills that are needed include both the basic skills of reading, writing, mathematics, speaking, and listening applied to the requirements of specific jobs, and the technical skills needed to perform specific jobs. Basic skills materials developed for elementary and secondary schools cannot be used to satisfy the requirements for training the adult workforce, and specific skill training is often not available. As a result, an assessment needs to be performed to determine the practical and economic viability of transferring existing DoD instructional materials to the civilian sector.

C. DOD INITIATIVES

For reasons of stability, effectiveness, and cost-effectiveness, the DoD has relied increasingly on interactive courseware (ICW) to meet its instructional requirements. To enhance the effectiveness of ICW programs, several initiatives have been taken. These include: (1) development of technical standards so that ICW programs can be used across a variety of system configurations; (2) establishment of a DoD Directive for development and management of ICW programs and a database, the Defense Instructional Technology Information System (DITIS), to facilitate sharing ICW programs within and across the Services; and (3) preliminary examination of the activities required to make instructional technology and instructional materials accessible to those outside of DoD.

D. THE TRANSFER OF DOD MATERIALS

An examination of the titles in the preliminary version of the DITIS database found that ICW programs fall into four categories: (1) Literacy and General Education, (2) Technical Training, (3) Managerial Education, and (4) Professional Skills Update and Enhancement. However, the detailed information needed to determine transfer candidacy for any particular program title is in the process of being gathered for entry into DITIS, so no conclusions can yet be drawn about the number of DoD ICW programs that are candidates for transfer to the civilian sector.

Experience with the Job Skills Education Program (JSEP) and Computer Assisted Medical Interactive-Video System (CAMIS) ICW programs was briefly reviewed. These programs provide valuable insights into the amount of resourcing that may be needed to enable outside users to prepare DoD ICW programs for their own use. This experience illustrates issues of "de-greening," portability, and organizational mission and responsibility that must be resolved before effective mechanisms can be established to transfer any DoD ICW programs to outside users.

E. ISSUES

The successful transfer of instructional materials from any agency to outside users is a complex undertaking. To effect such transfer for DoD instructional materials, three major types of issues must be resolved: (1) the need to articulate *specific* civilian instructional requirements; (2) the determination of methods to overcome fundamental differences between materials based on the warfighting requirements of DoD and the specific needs of the civilian sector; and (3) appropriate allocation of responsibilities to other Federal agencies, such as the Departments of Labor, Commerce, and Education, and private industry, for determining civilian requirements, modifying instructional content, reprogramming materials for different delivery systems, identifying and marketing to potential civilian users, and producing, warehousing, and distributing materials.

These factors are especially costly and complex when they involve technology-based instructional materials. These issues must be resolved and adequate resources of time, money, and personnel made available. It is only in this way that the goals and objectives of technology transfer can be satisfied.

I. BACKGROUND

The National Defense Authorization Act for Fiscal Year 1991 directed the Secretary of Defense to provide an assessment of programs developed by the Department of Defense (DoD) that can be made available to civilian organizations to provide immediate support and assistance to upgrade skills for better civilian employment opportunities. This report was prepared in response to that direction.

Interest in the DoD as a source of instructional materials that can be made available to outside activities has been growing for several years. A number of Congressional actions have been taken to facilitate and govern transfer of DoD materials and technologies to non-DoD applications. These actions include the following:

(a) *The Stevenson-Wydler Technology Innovation Act of 1980.* This act focuses on research and development. It authorizes the establishment of Centers for Industrial Technology and is intended to stimulate use of federally funded research and development products by state and local governments and the private sector. In the case of instruction, it facilitates and encourages transfer of research and development products from the DoD personnel research laboratories to non-DoD applications.

(b) *The Federal Technology Transfer Act of 1986.* This act also focuses on research and development. It amends the Stevenson-Wydler Act by authorizing cooperative research and development agreements between Federal and non-Federal laboratories and by establishing a Federal Laboratory Consortium for Technology Transfer within the National Institute for Standards and Technology.

(c) *The Training Technology Transfer Act of 1988.* This act, which is a chapter of the Omnibus Trade and Competitiveness Act of 1988, focuses on the transfer of federally-developed education and training software to non-Federal activities. The act is intended to facilitate transfer of education and training software from Federal agencies to applications that support the education, training, and retraining of industrial workers, especially workers in small business concerns. It specifically identifies the DoD as a potential source of instructional software. The act establishes an Office of Training Technology Transfer in the Department of Education, which is to maintain a clearinghouse of information on federally-developed education and training software.

This report focuses on interactive courseware (ICW). ICW is defined as computer-controlled courseware that relies on student input to determine the pace, sequence, and content of instruction delivery. Courseware by itself refers to all training materials, including the curriculum database and all disks, tapes, books, charts, and computer programs, necessary to deliver an ICW program.

The key distinction between an ICW program and all others is the provision, through use of computer technology, of interactions that tailor the instruction to the needs of individual students. The desirability of individualization in instruction has been noted throughout the history of instruction (Corno and Snow, 1986). By tailoring instructional content to individual needs, each student receives the level of detail, pace, remediation, and sequence of topics and interactions needed to learn the material efficiently within the limits imposed by time and access to other instructional resources. ICW programs provide individualized instruction within our current group-oriented instructional institutions. This advantage, combined with the fact that ICW programs tend to be developed as stand-alone, or autonomous, modules of instruction, make them promising candidates for smooth transfer to training in the civilian sector. Since they are also the concern of the Training Technology Transfer Act of 1988, they are the focus of this report.

Transfer of DoD education and training materials and technologies is motivated by civilian requirements. These requirements are briefly reviewed in Section II. Section III describes a number of significant initiatives taken by the DoD in response to its own requirements and those of non-DoD sectors. These initiatives were taken to improve management of ICW programs within the DoD, but they will also facilitate access and transfer of DoD ICW programs to outside agencies and the private sector. Section IV provides an assessment of the amount and kinds of DoD ICW programs that might be made available to meet civilian requirements and discusses some examples of DoD experience in transferring ICW programs to outside agencies. Section V discusses issues involved in transferring ICW programs.

II. CIVILIAN ENVIRONMENT

The interest in transferring DoD instructional materials to the civilian sector stems from the continuing deficit in skill levels of workers and the increasing emphasis on the use of high technology to perform jobs.

A. CIVILIAN TRAINING REQUIREMENTS

An examination of drop-out rates, scholastic achievement scores, and performance and test data from employees indicates that a substantial percentage of persons in the U.S. workforce have severe skill deficiencies. Deficiencies in the skills of persons in, or entering, the U.S. workforce have become particularly troublesome in the closing years of the twentieth century since greater demands are being made on the skills and competencies of the American worker.

At the same time, a recurring theme in many discussions about the U.S. economy is that human capital is becoming increasingly important for maintaining economic competitiveness. A report issued by the American Society for Training and Development (Carnevale, 1990) is indicative of the tone of many recent reports on this topic:

> By all accounts the American workforce is not ready to meet the new competitive standards. It is not adequately prepared to take advantage of new technology, especially information technology. It has not learned how to achieve results through the use of teams. For the most part, it does not have sufficient skills to leapfrog ahead of competitors in order to deliver quality, variety, convenience, customization, and timeliness. Business has not learned how to shift its focus to the customer, how to engage in partnerships with its competitors, or how to think in terms of global markets. In short, it has a great deal to learn in a hurry. (p. 2-3)

Carnevale and Gainer (1989) summarize a series of analyses that found the percentage of the GNP accounted for by resources from the earth (such as minerals, energy, and food) is declining. In 1890, these resources accounted for 50 percent of the GNP. Today these resources account for 10 percent of the GNP, and human resources now account for more than four-fifths of the nation's economic output. Bishop (1989) analyzed the impact of training on the productivity of workers and found that workers who receive formal job training have a 30 percent higher productivity level than workers who

are not formally trained. With regard to the benefits of training for workers, those receiving on-the-job training have a 25 percent salary advantage over workers who do not receive formal training (Carnevale and Gainer, 1989).

The American Society for Training and Development (1990) has estimated that in 1989 the total cost to retrain the American workforce who did not receive training would have been $64 billion of which $45.4 billion would have been the employer share, and the remainder, consisting mostly of tuition and related instructional fees, would have been made by the workers themselves. The number and percent of workers who needed but did not receive retraining, and the cost of that retraining, are shown as follows:

Type of Retraining	Number & Percent Who Needed but Did Not Receive Retraining in 1989	Money Needed for Retraining (Billions), Employer Share
New Technology Training		
Technical Workers	9,255,270 (8%)	$8.7
Skilled Workers	6,815,680 (6%)	6.5
Executive Management and Supervisory Training	5,490,374 (5%)	9.7
Customer Service Training	11,394,240	5.4 (9%)
Basic Skills Training	16,559,243	15.1 (14%)
Totals	49,514,807 (42%)	$45.4
Total Employment for 1989:	117,342,000	

The problem of making substantial improvements in the skill levels of the American workforce is complex and unlikely to be solved by any one action. Given the magnitude of the problem, it is not surprising that there is interest in finding ways to ensure that existing and effective training materials have maximum impact and accessibility.

B. CIVILIAN SKILL REQUIREMENTS

Many reports dealing with training needs for the workplace suggest that today's workers need more and better skills. The discussions surrounding this position are often

vague and fail to provide concrete definition of the skills sought. The most commonly used term to describe this requirement is "basic skills." The term "basic skills" is generally compatible with the way it was used in the 1990 Office of Technology Assessment report on worker training (i.e., basic skills are reading, writing, mathematical concepts and operations, and communication skills--speaking and listening). Without exception these skills are identified among the critical deficiencies in the workforce. Every report that was examined included these skills in their discussion of basic skills. However, basic skills materials developed for elementary and secondary schools cannot be used to satisfy the requirements for basic skills training in the adult workforce. Research dealing with workplace reading, mathematics, and writing in both military and civilian settings indicates that on-the-job reading tasks differ substantially from academic reading tasks (Carnevale, Gainer, and Meltzer, 1990).

Technical skills are also increasingly needed. One report (1988) issued jointly by the Departments of Labor, Education, and Commerce provides two examples of the ways in which jobs require increasingly greater technical skills. Even though bank clerks and couriers have the same title today as they did 10 years ago, their jobs are now quite different. Bank clerks handle fewer standardized requests, and more of their time is spent analyzing problems, working with incomplete information, identifying sources of information, and penetrating poor documentation. Federal Express, which once hired high school dropouts as couriers, now finds that it must hire persons who can understand the new technology well enough to make effective use of it. Most analyses of the marketplace suggest that change will continue to be the norm.

C. SECTION SUMMARY

Sources of economic health in the United States have shifted from natural, physical resources to the nation's workforce, which now accounts for more than four-fifths of the nation's output. There are skill deficiencies in the American workforce. These deficiencies and the costs to remove them increase every year that the people who need training do not receive it. In 1989 the proportion of people who needed training and did not receive it was estimated to be 42 percent of the total workforce.

The skills that are needed include both the basic skills of reading, writing, arithmetic, speaking, and listening as applied to the requirements of specific jobs, and the technical skills needed to perform them. Basic skills materials developed for elementary and secondary schools cannot be used to satisfy the requirements for basic skills training in

the adult workforce. Requirements for technical skills training have grown because of the rapid introduction of technology into the workplace. Some jobs (e.g., computer technician) start out with technical requirements, but many jobs (e.g., bank clerk) have raised their technical requirements as technology for performing them has been introduced. The training that is needed to meet these requirements must therefore cover both basic skills and specific, but widely needed, technical skills.

III. DOD INITIATIVES

The courses presented by the DoD range in length from less than a day to more than a year. The format of this instruction ranges from traditional platform lectures using textbooks to correspondence courses to field exercises involving actual equipment and live ammunition. The instructional technology used also spans the full range and includes lesson plans, study guides, workbooks, instructor guides, overhead transparencies, textbooks, workbooks, programmed textbooks, audio cassettes, films, videotapes, computer-assisted instruction, computer-managed instruction, interactive videodisc instruction, CD-ROM instruction, part-task simulators, two-dimension simulators, high-fidelity simulators, laser-simulated weapons fire, networks of simulators, and actual equipment.

Increasingly, the DoD relies on interactive, computer-based courseware (ICW) to support its instructional needs. There are several reasons for this:

(1) *Stability*. The development of movable type and books provided a capability to capture the content of high-quality instruction and deliver it inexpensively to many people. However, the effectiveness and efficiency of instruction varies if content is presented using different rules and procedures. In addition to content, computer technology captures the interactions of high-quality instruction and makes them widely, inexpensively, and reliably available to many people. ICW programs cannot yet supply all the interactions of an individual tutor working with an individual student, but they can capture a significant portion of it. What interactions they do provide--along with the instructional content--can then be delivered in a stable, autonomous fashion to learners, with a minimum of the variability that is characteristic of human instructors.

(2) *Effectiveness*. There have been enough reviews of the effectiveness of computer-based instruction that a review of the reviews (Niemiec and Walberg, 1987) has been published. It indicates an improvement of about 14 percentile points in student achievement through the substitution of computer-based instruction for more conventional approaches. A suggestion of the improvements to be expected in the wider world of ICW using multimedia approaches were provided by Fletcher (1990), who found improvements of about 19 percentile points through the use of interactive videodisc instruction.

(3) *Cost-effectiveness.* One significant measure of cost when students are being paid by the organization that trains them is time spent in training. A very stable finding for ICW has been that it reduces training time by about 30 percent over more conventional means (Orlansky and String, 1979; Fletcher, 1990). A second source of cost reductions through the use of ICW involves its ability to substitute simulation for actual equipment without adversely affecting student achievement. Use of simulations that may cost a tenth or even a hundredth of the actual equipment used in military systems has provided a powerful cost incentive for using ICW programs to train operators and maintainers of military systems.

Several actions to improve the management and use of ICW programs within the DoD have been initiated. These actions include the development of policies, technical standards, and a new automated reporting system and data base that will improve the sharing of materials inside the DoD and outside, with non-DoD activities. These initiatives were undertaken jointly and cooperatively by the OASD(FM&P) Readiness and Training Directorate and the OASD(PA) Defense Audiovisual Policy Office. They center on three areas: (a) ICW portability; (b) development and management of ICW; (c) procedures for transferring ICW within the DoD.

A. THE DOD PORTABILITY INITIATIVE

Over the next several years, the DoD will continue to invest in the development of interactive instructional materials. To support these materials, the military Services--along with many other government and civilian organizations--are acquiring a variety of computers, videodisc players, CD-ROM devices, and associated interfaces. The DoD has initiated a significant effort to make its courseware portable and, therefore, more affordable and accessible to users within and across the Services. Without portability, courseware developed for one system configuration must be re-programmed to operate on a different system configuration. Substantial development and delivery costs can be avoided if ICW programs are programmed from the beginning to operate on a variety of system configurations. Portability of this sort is accomplished through establishment and observance of standard practices in the development of ICW programs.

The DoD, therefore, has taken the initiative and the lead in working with industry to develop technical standards that allow ICW programs produced on one system configuration to operate on many others. This project, called Portable Courseware (PORTCO), brought together the efforts and expertise of the Interactive Video Industry Association, the Navy Personnel Research and Development Center, the Naval Training

Systems Center, the Institute for Defense Analyses, the National Institute for Standards and Technology, the Defense Readiness and Training Directorate, and the Defense Audiovisual Policy Office. The intent of this effort is to ensure as much courseware portability as possible, without increasing the incremental costs to produce courseware in accord with these standard practices.

The approach chosen by the DoD is based on a standardized, virtual interface. It provides both the portability needed for widespread Service use and the flexibility to satisfy the various needs of different users, developers, and vendors. A standard based on this approach was developed by a working group of the Interactive Multimedia Association which was supported jointly by the DoD and industry. The resulting set of standard practices is being widely adopted by industry and it has been incorporated in MIL-STD-1379D, "Military Training Programs" (5 December 1990). Based on the DoD initiative, the National Institute for Standards and Technology (NIST) has adopted the initial standard as a foundation for a Request for Architecture issued to solicit suggestions and recommendations from industry for further development. The product of this DoD/NIST effort will be offered for adoption as a Federal, national, and international standard.

Next steps in the DoD initiative are to include digital audio in the standard, an extension that is being developed in cooperation with another industry association, the Aircraft Industry Computer-Based Training Committee, to develop a device level, "plug and play," capability, and to extend the standard to operating system portability based on an open systems architecture. The DoD has sought cooperative relationships with a number of organizational bodies in government and industry that are pursuing the same ends. The end result should promote much greater use of a highly effective form of instruction, wider competition among suppliers, and lower per-unit costs of ICW programs.

B. ICW DIRECTIVE

A new DoD Directive (DoDD 1322.bb, "Development and Management of Interactive Courseware (ICW) for Military Training") has been developed and formally coordinated with the DoD Components and is about to be released. The directive establishes DoD policy, prescribes procedures, assigns responsibilities, and establishes information requirements for using ICW programs to train military personnel. The major thrusts of the directive are to establish: (1) technical standards to promote the portability of ICW programs between multiple delivery systems, (2) a database of DoD ICW programs to

promote sharing of resources between DoD Components, and (3) procedures to improve the life-cycle management of ICW programs.

Specifically, the directive sets five policies for the development and management of DoD ICW programs and materials. First, ICW programs are to be designed to promote portability, following the standard DoD programming protocols developed under the DoD portability initiative and other technical requirements prescribed in MIL-STD-1379. Second, the directive minimizes payment of royalties, recurring license or run-time fees, use taxes, or similar additional payments for courseware and associated materials developed for or by the DoD. Third, the directive establishes the Defense Instructional Technology Information System (DITIS) to provide an inventory and maintain a catalog of DoD ICW programs for use by all DoD Components. Fourth, the directive requires that reproduction master materials be archived for the life cycle of each ICW program. Fifth, the directive establishes the policy that the DoD Components ensure the availability of all materials necessary to modify ICW programs throughout their life cycles.

In support of these policies, the directive also provides specific procedures. These procedures fall into two categories: development procedures and management procedures.

The directive lists a number of specific procedures that must be followed in developing ICW programs for or by DoD Components. To help maximize the effectiveness of DoD ICW programs and materials, the directive requires that all ICW programs be based on comprehensive requirements and media selection analyses so that program development can be properly prioritized and targeted. In addition, the directive requires that the DITIS inventory of existing ICW programs be reviewed before program development or acquisition to determine whether an existing DoD program can be acquired from another Component or agency that will adequately meet the needs of the development effort under consideration.

In addition, the directive requires DoD Components to obtain, to the extent authorized by the Federal Acquisition Regulations, the unlimited rights or Government-purpose license rights to the courseware, associated presentation programs necessary to interpret and execute the courseware, documentation, and associated training materials for all ICW programs developed. This procedure, combined with the requirements for the use of the portability protocols and development of logistic support packages will help ensure the transferability and portability--within the DoD--of ICW programs and materials.

As far as management procedures are concerned, the directive deals with two major issues. The first of these is the establishment of life-cycle management activities responsible for each ICW program, and the outlining of basic procedures for these activities to ensure the portability and availability of ICW programs and materials within DoD Components and activities. Secondly, the directive requires that DoD Components ensure the life-cycle availability of the version of the authoring program, assembly language, or higher order language compiler used to develop the courseware; source code for the courseware; concomitant documentation; all associated software libraries; and all other materials necessary and sufficient to modify the courseware through either archiving or escrow procedures as appropriate. In this way, availability of all materials necessary to modify or update ICW programs will be ensured throughout the life of the the ICW program.

Much of the policy and procedures stated in the directive will increase the ability of the DoD to share ICW programs and materials. However, the directive--and its concomitant policies and procedures--were developed to increase the effectiveness and efficiency of military education and training. The programs that will be listed in the DITIS inventory have been developed for military education and training, and it cannot be assumed that most of them will be appropriate for transfer to the civilian sector. For those programs that are appropriate, the directive will help ensure that the transfer can be accomplished in a more efficient manner.

The impact of this directive on DoD management of ICW programs will be substantial. It encourages free and open competition among vendors providing ICW programs to the DoD and can be used as an example by all Federal agencies in making these purchases. When fully operational, DITIS will satisfy the information reporting requirements of the Department of Education Clearinghouse established by the Training Technology Transfer Act of 1988. The Defense Training Performance and Data Center, which will maintain the DITIS file has already begun to assemble information for it.

Perhaps the biggest advantage of the directive in terms of the current report and transfer of materials is that it considers many of the issues restricting the transfer of ICW programs and materials and presents ways to eliminate them. Although the directive focuses on military training and education, it represents a reasoned approach to minimizing the problems inherent in today's diverse technology-based instruction and to maximizing the efficiency and effectiveness of training technology transfer between organizations.

C. TRANSFER PROCEDURES

Instructional technologies such as training devices, simulation, programmed instruction, computer-based instruction, computer-managed instruction, achievement testing, adaptive testing, instructional networking, systems approaches to instructional development, artificial intelligence and its application to computer-assisted instruction, and other instructionally relevant technologies find their roots in research and development originally supported by the DoD (Blaiwes and Regan, 1986); Fletcher and Rockway, 1986; Office of Technology Assessment, 1989). Transfer of these technologies from the DoD to non-DoD applications has been successful, and it has had a substantial impact on the history of instruction in this country. However, this transfer has not been accomplished for free. In nearly every case, non-DoD applications had to be funded and re-developed by their sponsoring organizations in order to demonstrate the utility of these technologies to civilian activities and to initiate their implementation and adoption outside the DoD.

Transfer of some training materials has also been accomplished. The DoD (as well as other Federal agencies) has provided many training and education audiovisual materials, some of which are interactive, to the general public, private industry, and educational institutions through an existing structure within the National Audiovisual Center as outlined in the Office of Management and Budget Circular A-114, "Management of Audiovisual Activities." Since this mechanism is already in place, the DoD intends to follow an analogous process for making appropriate interactive audiovisual materials used for instruction available in accord with Public Law 100-418. Master copies of interactive audiovisual materials that are intended for instruction and that are suitable for release will be reviewed by DoD counsel to ensure that no legal encumbrances preclude their sale to the public and will be subjected to a security review process to determine if they can be cleared for public release. Interactive audiovisual materials that receive both a favorable legal review and public clearance will then be offered directly as they were produced for the DoD. The DoD can not take responsibility for any costs associated with secondary user desired content changes, editing, duplication, shipping, technical conversion, licensing, patents, or royalties associated with these cleared audiovisual materials.

These costs may represent a substantial investment. ICW programs are more complex than linear audiovisual programs and require more resources to classify, test, store, market, and distribute them than do linear audiovisual programs. Among the reasons for additional resource requirements are:

- *Classification.* Audiovisual programs may be classified by the type of medium used to present them. ICW programs (some of which are audiovisual programs) are by their nature multimedia and, because their instructional interactions are based on the capabilities of computer technology, they may employ a variety of instructional approaches that transcends the capabilities of any medium. It is frequently noted in research literature that classification of ICW programs based on the media they use is misleading (e.g., Clark, 1983).
- *Testing.* Linear audiovisual programs can generally be depended on to function properly when delivered; however, due to lack of standardization at all levels, which likely stems from the newness of the technology, ICW programs cannot. They must be tested, and this testing requires access to a wide variety of equipment, equipment configurations, interfaces, software, authoring systems, operating systems, and the technical expertise to use all these properly.
- *Marketing.* The functionality and many of the technical aspects of linear audiovisual media and programs are well understood by many members of the public. The functionality and technical aspects of ICW programs, valuable as they are, are generally poorly understood by both the public and many professionals in training and education. Explaining what an ICW program offers and why it is important is a major, difficult task in marketing it.
- *Delivery.* Similarly, linear audiovisual programs can generally be transferred successfully to new users with little need for technical interaction before or after the hand-off. Anyone who is familiar with the need for hotlines and dealer support required by users of publicly sold software will understand the necessity and value of the continuing technical advice that must be available to users of ICW programs.

Nonetheless, some DoD instructional materials may be suitable for transfer to non-DoD activities. The central question, is how many? If there are few, then the attention paid and resources allocated to transferring material out of the DoD may not be worth the effort already expended on the question. If there are many, then more effort and resources should be provided to effect the appropriate transfer. In assessing the amount of material suitable for transfer it is useful to consider the process, analogous to the process now used for audiovisual materials, that would most likely be followed to arrive at the list or catalog of candidate transferrable materials. This process would involve at least three "filters" or reviews through which ICW programs must pass: (1) a suitability review; (2) a security review; and (3) a legal review.

- *Suitability Review.* The first question that arises about DoD instructional material is: Would anyone want it? It is worth noting that a substantial amount

of DoD instructional material is specifically focused on the main business of the DoD, which is warfighting. There is much instructional material concerning combat and the operation, maintenance, and deployment of materiel required for combat. Some of this material may be of interest to the foreign military sales community, but the concern with this report is with transfer of materials to non-DoD uses in the United States, and it is assumed that instructional materials directly concerned with combat or with systems that are only used for combat would be excluded from further consideration.

- *Security Review.* Classified material or material that reveals business proprietary information or trade or technology secrets cannot be transferred to the public domain. Instructional material that could be transferred by the DoD to non-DoD activities would have to be material that was reviewed by the DoD to determine if it could be made available for public release and unlimited distribution outside the DoD.
- *Legal Review.* The most restrictive review for DoD instructional materials to pass may turn out to be the legal review. Here the question is: Does the DoD have the legal right to provide instructional materials for copying and distribution by others? In short, does the DoD own it? Much of the instructional material used by the DoD has restrictions on its distribution. These restrictions are the result of several factors: the software used in ICW programs may be copyrighted; imagery, music, and sound effects used in audiovisual components may be copyrighted; and distribution rights may be restricted to DoD users only. Clearly, the DoD does not have the right to copy and distribute these materials.

In other cases, the distribution rights for the materials themselves are unlimited, but the means to present them are limited. This is especially likely to be true of ICW programs in which instructional content--the curriculum data base of items, scenarios, graphics, photographics, audio/visual productions, and the like--is only part of the instructional package. The rules and procedures for presenting and individualizing the instructional content are a separate matter. The content may be wholly owned by the DoD with free and unrestricted rights for its distribution, but the rules and procedures for presenting it may involve proprietary algorithms, licensing, royalties, or other limitations to the rights of the DoD to transfer it to non-DoD users.

These legal restrictions are intended to be minimized by the new ICW Directive. However, it cannot solve the problem entirely. Also, distribution rights to ICW programs remain to some extent uncharted territory. An adequate body of decisions for establishing legal precedents for the distribution of ICW programs to outside users has yet to be

accumulated. Clear criteria for developing ICW programs with well-understood distribution rights and clear criteria for determining distribution rights for existing ICW programs have yet to be developed.

It is also uncertain what legal liability issues may be associated with transferring certain ICW materials to non-DoD and public users. Potentially transferrable materials may have to be legally reviewed in this context as well.

The process, then, under consideration by the DoD for transferring ICW programs to non-DoD users centers on these three reviews. Security review, although performed on all materials transferred outside the DoD, may cost additional DoD resources due to the increased workload associated with the ICW materials. Both the suitability review and legal review will certainly result in new, nonmission-related costs that the DoD will have to bear and that will require additional resourcing.

Once these reviews are completed, the instructional materials that emerge will be listed in a catalog that will be made available to the Department of Education Clearinghouse. In addition, there are tasks that must be performed by non-DoD organizations to complete the transfer of the materials to civilian users. Among these are the following:

- The catalog must be published and disseminated to potential users. This task includes maintaining mailing lists and developing a capability for marketing the DoD materials. The catalog must include materials newly entered, pre-existing materials that have been updated, and materials whose distribution status has changed. The catalog should be maintained in a digitally accessible format as well as in a paper format.
- Transferred materials must be physically stored with all necessary environmental safeguards. These materials must be maintained in good working order, and updated and modified promptly by the organization responsible for marketing them. Software, hardware, and an in-house technical capability must be available in order to provide this quality assurance.
- Non-DoD users will also require technical assistance in installing the DoD materials for their own applications, and this assistance will have to be provided via telephone hot lines, technical bulletins, user group seminars, and the like.

Other tasks may well develop with experience. What is needed is an adequately resourced materials transfer organization with clear responsibility to market, technically support, and transfer DoD ICW programs to non-DoD users. If the DoD materials and other government-developed ICW programs are of sufficient value, such an organization

should become self-supporting after receiving start up support, but adequate seed funding will have to be provided and an organizational "home" for the center will have to be established.

D. SECTION SUMMARY

For reasons of stability, effectiveness, and cost-effectiveness, DoD has relied increasingly on interactive courseware (ICW), which uses many forms of instructional materials and technology to determine the pace, sequence, and content of instruction needed by individual students.

The DoD has undertaken several initiatives to improve the management and use of its ICW programs. These initiatives include: (1) development of technical standards for portable ICW so that ICW programs can be used across a variety of system configurations; (2) preparation of a DoD Directive for management and use of ICW to ensure that portability and other cost-effective standards are observed and to provide a database (the Defense Instructional Technology Information System, or DITIS) that will facilitate sharing ICW programs within and across the Services; and (3) development of preliminary transfer procedures for making instructional technology and instructional materials accessible to outside agencies through performance of a suitability review, a security review, and a legal review and provision of a catalog that lists instructional programs that successfully pass these reviews and are candidates for transfer.

IV. TRANSFER OF DOD MATERIALS

A. DITIS REVIEW

The proposed DITIS database, when fully operational, will be the only DoD database that will satisfy the information reporting requirements of the Training Technology Transfer Act of 1988. The current DITIS database contains a preliminary listing of some of the ICW programs that are now used in the DoD. Since full-scale development of the database has not yet been started, the initial records that have been entered are not suitable for a definitive empirical analysis. Although many data items have not been completed in many of the data records, it was possible to review the program titles to make an initial assessment of the potential of DoD programs for transfer to outside agencies.

About 45 percent of the ICW programs now listed in DITIS are implemented on the PLATO computer-based instructional system, another 45 percent are implemented on the TICCIT computer-based instructional system, and the remaining 10 percent are generally implemented on various desktop microcomputer systems. The implementation systems are probably atypical of most DoD ICW programs, but the subject matters they cover appear to be fairly representative.

These preliminary DITIS titles were examined for possible non-DoD uses. Programs that dealt only with military-specific equipment or procedures, course management tools without accompanying training packages, and non-training computer programs and applications software were specifically omitted. Following this initial screening, two criteria for applicability were used to screen the remaining ICW programs: (1) existence of a similar job in the civilian sector; (2) existence of a civilian vocational area that requires the skills taught.

These programs were then divided into two groups: (1) generic programs that deal with basic literacy or general education; and (2) more specific programs that deal with job- or vocation-related skills. The first of these categories relates to Congressional interest in job skill enhancement programs; the second relates to Congressional interest in retraining and skill enhancement.

Several lower order categories were found in the ICW programs that deal with basic literacy and general education. These categories covered topics in general education, including all basic verbal and mathematical literacy skills, subject area-specific preparation for advanced education, learning skills (including learning strategies and reference skills), and personal development skills necessary to function as an adult in modern society (e.g., maintaining a checking account). More specifically, the programs fell into the categories of: (1) College Level Entrance Preparation (CLEP); (2) Chemistry; (3) General Education Development (GED) Preparation; (4) Language Skills; (5) Foreign Language Training; (6) Learning Strategies; (7) Mathematics Skills; (8) Personal Development; (9) Reference Skills; and (10) Miscellaneous.

Although some of the Literacy and General Education programs were developed along traditional educational lines emphasizing literacy fundamentals isolated from specific application, others (such as those in the Job Skills Enhancement Program) present basic skills within a job-related or practical context.

As far as programs related to job- or vocation-related skills are concerned, the DITIS records fell into three major categories: Technical Training, Managerial Education, and Professional Skills Update and Enhancement.

The category of Technical Training includes ICW programs covering instruction in the knowledge, skills, and abilities necessary to perform non-professional jobs (i.e., jobs that do not require training in the liberal arts and/or sciences and advanced study in a specialized field). More specifically, the programs fell into the categories of: (1) Basic Technical Skills; (2) Safety; and (3) Specific Vocational Skills.

The category of Managerial Education includes ICW programs covering instruction in the skills necessary to direct and administer groups of people and/or processes within an organization. More specifically, the programs fell into the categories of: (1) Administration and Personnel; (2) Career and Personnel Development; (3) Equal Employment Opportunity and Affirmative Action; (4) Health Care Administration; (5) Instruction and Training; (6) Leadership and Management; (7) Motivation; (8) Office Management; (9) Production Control; (10) Time Management; and (11) Miscellaneous.

The category of Professional Skills Update and Enhancement includes ICW programs covering instruction to maintain, update, and improve vocation-specific knowledge, skills, and abilities related to specialized fields requiring advanced education

and training. More specifically, the programs fell into the categories of (1) Engineering and (2) Medicine.

Of the DITIS titles covered by this analysis, about 10 percent were JSEP programs, most of which were in the category of Basic Skills Training and General Education, but some of which were in the category of Technical Training. As stated above, the JSEP programs were developed to teach skills within a job context rather than in isolation. No data were available concerning the development philosophy for the other programs.

Although at first it appears that there are numerous ICW programs listed in the preliminary DITIS database that are adaptable to training in the civilian sector, several cautions should be noted. Each program was sorted on the basis of its title using the criteria discussed above. Many of these preliminary DITIS records do not include a list of key words and concepts, so no additional data were available to perform the sort. Although rejection criteria determined the applicability of a program to civilian training, the decision was made to include more rather than fewer programs until more information can be obtained.

Since the ICW programs were categorized on the basis of titles and without a comprehensive examination of the programs themselves, there are further complications to note. One of the greatest problems in transferring ICW programs to civilian applications is that it is often saturated with Service-specific information--ranging from personnel dressed in uniforms to references in the instruction to policies, procedures, acronyms, and the argot of the military. Although DoD ICW programs may be transferred to civilian users, too much military-specific, or "green" (for Army green), information may compromise the effectiveness and/or acceptability of the instruction in civilian applications.

As discussed above, there may be legal complications in transferring DoD ICW programs to the civilian sector. If the DoD does not own the rights to the programs, it can not transfer them to another DoD or Government agency, let alone to civilian users, without copyright infringement or other violations of contractual agreements.

The lack of comprehensive data for the current analysis requires that the results of this assessment be treated as preliminary. More information is needed before comprehensive, empirical analyses of current DoD ICW programs can be completed. However, enough ICW programs appear applicable to the civilian sector in the preliminary DITIS database to warrant a closer examination of the issue. Although a comprehensive, empirical analysis is not yet possible, in the future many more--and more complete--records

will be entered into DITIS. The initial findings of this study warrant further examination of the database at that time.

B. EXAMPLES OF TRANSFERRED MATERIALS

1. Job Skills Education Program (JSEP)

JSEP presents the most extensive and most recent effort to transfer DoD-developed materials to non-DoD applications. JSEP was originally developed for the Army Continuing Education System (ACES) by Florida State University and Ford Aerospace Corporation under the direction of the Army Research Institute for the Behavioral and Social Sciences (ARI). It is designed to assist individuals to improve the academic skills required to learn a specific occupation and to be better prepared for employment or subsequent education and training. It currently exists in its original Army version and in a civilian version based on the Army version.

The Army version is an individualized, computer-based instructional system designed to improve soldiers' abilities to learn their military jobs--their Military Occupational Specialities, or MOS. This version operates on both the PLATO® and MicroTICCIT® computer systems. It consists of about 300 lessons addressing about 200 general academic skills identified by an extensive analysis of 94 Army MOS in which about 85 percent of all enlisted soldiers are employed. There are three types of lessons in JSEP: (1) verbal lessons that teach reading and writing skills; (2) quantitative lessons that teach mathematics skills; and (3) learner strategies lessons to improve students' abilities to learn and benefit from instruction. Students are guided through lessons selected for them by a computer program that keeps track of their attendance and performance data and provides progress reports for students, instructors, and administrators.

The civilian version of JSEP was developed under an interagency agreement jointly signed by the Departments of Education, Labor, and Defense to transfer technology developed by the government to civilian sectors. JSEP is the first major computer-based instructional program to be revised for civilian use. The civilian version takes advantage of similarities between Army and civilian jobs. In preparing the civilian version, the original military analyses of 94 MOS were used to devise JSEP instruction for about 20 civilian occupations taken from the Dictionary of Occupational Titles. About 90 percent of the Army materials were found to be usable in the civilian version. The civilian version operates on the MicroTICCIT computer system, which networks individual student

workstations with a central host system and uses the MS/DOS operating system. This version and initial evaluations of it were documented by Philippi (1989) and Fisher, Philipi, Frederick, Moore, and Rebata (1990) for the National Alliance of Business and by Dick and Branson (1990) for Florida State University and Ford Aerospace. The results of the evaluations found civilian JSEP to be instructionally effective and well accepted by the students. The following findings are more directly relevant to the issue of transferability:

(a) Additional "de-greening" may be needed. The students indicated that residual indications of JSEP's Army origins were noticeable but not distracting. JSEP instructors felt that all indicators of the Army origins of JSEP should be removed. "Greeness" may affect civilian acceptance of JSEP, regardless of its impact on instructional effectiveness.

(b) JSEP computer systems are relatively expensive and incompatible with commonly available computer systems. The DoD portability initiative should ameliorate this problem in future ICW programs, but for JSEP it remains a stumbling block. Proprietary software and hardware is currently required to operate it.

(c) More technical support is needed for both JSEP courseware and software. As was noted above in contrast with linear audiovisual programs, users need ready access to accurate and clear technical advice before, during, and after implementation of ICW programs.

Notably, copyright of JSEP materials and source code is not a problem. Copyright for these items was obtained by Florida State University and then assigned to the Army. (Copyrights cannot be owned by the government, but they can be assigned to it.) However, the authoring system used for JSEP must be present to operate JSEP materials and it is proprietary.

On the basis of these results, it appears that transfer of JSEP to civilian application is desirable, but more complex--and less "immediate"--than many expected it to be. Efforts by non-DoD organizations continue to be made to transfer JSEP to non-DoD organizations, which currently include the Cumberland/Salem Job Training Consortium in Bridgeton, NJ, the National Education, Development, and Training Center operated jointly by Ford Motor Company and the United Automobile Workers at Ford's Cleveland, Ohio, Engine Plant #2, the Greater Hartford Alliance for Literacy at the Greater Hartford (CT) Community College, the Alliance for Employee Growth and Development jointly sponsored by American Telephone and Telegraph Company, Communication Workers of America, and the International Brotherhood of Electrical Workers, and the Enhanced Training

Opportunities Program jointly sponsored by American Telephone and Telegraph Company and the International Brotherhood of Electrical Workers. Whether or not the costs to resolve the transfer issues represent significant savings over developing a new JSEP based on new occupational analyses of civilian skills requirements or from the occupational analyses performed in the beginning, remains an important, undecided issue that may be settled by these trial implementations.

2. Computer Assisted Medical Interactive-Video System (CAMIS)

CAMIS also provides an example of the issues that arise in the transfer of DoD-developed programs to non-DoD users. CAMIS has been under development by the Naval Health Sciences Education and Training Command (NHSETC) for more than 10 years (Toth and Strub, 1987). It uses interactive videodisc technology to improve the quality and availability of Navy medical training through realistic tutorial simulations of combat, mass casualty, and shipboard emergencies. As of 30 September 1990, 29 CAMIS productions had been completed and released, and 9 more were in production. Titles include general topics such as Homeostasis, Musculo-Skeletal System, Circulatory System, Basic Medical Skills, Oral Examination Assisting, and Dental Emergencies. About eight of the productions (e.g., Field Combat Casualty Management; Preventive Medicine in the Combat Theater: Regimental Surgeon) appear to be closely tied to naval combat requirements. Most of the remaining 30 productions could be used in civilian medical instruction.

Portability has been difficult with current CAMIS materials. Several different contractors developed the CAMIS lessons, and they used different technical approaches so that different means are needed to port CAMIS lessons across different suites of hardware and different operating systems software. Efforts are underway to make all CAMIS lessons compatible with the portability guidelines in the new ICW Directive and the recently signed MIL-STD-1379D, both of which are products of the DoD portability initiative. This is a retrofitting process that is needed within DoD management of CAMIS, but it would have to be performed in any event if non-DoD organizations were to use these materials. If the retrofitting and reprogramming were not necessary for DoD use, the considerable costs for these activities would have to come from non-DoD sources.

The CAMIS experience provides an example of both what is required to effect transfer of ICW materials and the importance of standard development procedures such as those established by the DoD portability initiatives. Legal restrictions on ownership do not seem to be a significant problem for CAMIS materials. The source software, the videodisc

imagery, and other information held on videodiscs appear to be candidates for transfer. Legal issues with regard to liability, however, have yet to be resolved.

The Human Resources Research Organization (HumRRO) and Lunaria, Inc., developed CAMIS materials for NHSETC and were awarded a contract by the Department of Transportation's Small Business Innovative Research Program to investigate the feasibility of transferring CAMIS materials to non-DoD activities (Hargan and Rice, 1988). The instructional goal in this case was to use CAMIS interactive videodisc instruction to develop and sustain the skills of civilian emergency medical technicians and paramedics. In general, the CAMIS materials were found to be well received by students and instructors and instructionally effective. There were no problems with the fact that both the victims and the health care professionals shown in the program were Navy personnel. The main problems centered on differences between Navy procedures and equipment for dealing with emergencies and the procedures and equipment used in the geographical area of the assessment. These were not DoD versus civilian issues, but issues that arose because there are no standard medical operating procedures and equipment that are widely used across all civilian activities.

C. SECTION SUMMARY

An examination of the titles in the preliminary version of the DITIS database found ICW programs in the four categories of Literacy and General Education, Technical Training, Managerial Education, and Professional Skills Update and Enhancement. This examination found many titles for ICW programs that might be candidates for transfer to non-DoD activities. However, the data elements for determining transfer candidacy on any basis other than program title are not yet collected or entered in DITIS, and conclusions cannot yet be drawn about how many DoD ICW programs are transferable.

Experience with the JSEP and CAMIS ICW programs was briefly reviewed. This experience showed that the redesign costs for JSEP were high and suggest that substantial resourcing is needed to enable non-DoD users to prepare ICW programs for their own use. This experience further illustrates issues of "de-greening," portability, and organizational mission and responsibility that must be resolved before effective mechanisms can be established to transfer any government-developed ICW programs to non-DoD users.

V. ISSUES

The successful transfer of instructional materials from any agency to outside users is a complex undertaking. Three major factors need to be considered in transferring DoD instructional materials to the civilian sector: (1) the needs of the civilian sector, (2) assets and limitations of the DoD in meeting these needs, and (3) allocation of responsibilities and resourcing for the process. These factors and some of the issues involved in each are discussed in the following subsections.

A. CIVILIAN NEEDS

There are two basic needs for training and retraining in the civilian sector--enhancement of basic literacy skills and general educational level of the workforce, and upgrading skills of both incumbent and incoming workers to help increase the United States' economic viability in the world market. As discussed in Section II, there is currently a need in the adult civilian population in general and in the civilian workforce in particular to eliminate functional illiteracy and, in many cases, raise the general level of education. Meeting these needs would enhance the ability of potential workers to find employment, and reduce the drain on the national economy by reducing unemployment.

In addition, not only do workers need to have a basic level of skill in literacy fundamentals, they must also be able to compete in the changing workplace environment with its increased emphasis on high technology for the production of goods and services that are salable in today's global marketplace. Such retraining and skill upgrading is one of the precursors to improving U.S. standing in the global marketplace.

Both of these are laudable goals, and it is only natural to try to use existing instructional materials to meet them. However, although these general needs are recognized, the specific requirements to fulfill them have not yet been determined well enough to know whether or not transfer of materials from the DoD--or any organization--is worthwhile. To attempt to fix one problem (i.e., civilian training and retraining needs) without an in-depth assessment and careful planning will only create another (i.e., the costly acquisition of materials that are not usable due to differing technologies and delivery media or instructional content that does not meet the training requirements of the target

organization). An assessment of the assets and some of the limitations inherent in the transfer of DoD instructional materials without such assessment and planning is discussed in the following section.

B. DOD ASSETS AND LIMITATIONS

The instructional materials developed by and for the DoD are based on a comprehensive analysis of military training requirements, and are specifically tailored for the defense and military arenas. As a result, a substantial amount of this instructional material is centered around the DoD mission--warfighting. For example, much of the DoD's instructional material concerns combat and the operation, maintenance, and deployment of materiel required for combat. Most of these materials are not applicable in the civilian sector.

However, since both the military and the civilian workforce draw on the same population for personnel, many of the same basic education and training problems exist in both arenas. As a result, the DoD has developed some instructional materials that deal with the problems of basic literacy, general education, general technical training, managerial education, and professional skill upgrade and enhancement. However, as stated previously, these materials are based on a comprehensive front end analysis of the specific *military* training needs. This results in instructional materials that are effective for their intended military purpose, but are of unknown utility and applicability to the civilian sector. Therefore, the transfer of materials is not just a matter of making available copies of DoD instructional materials to potential users, outside transfer agencies, or the Department of Education Clearinghouse. To maximize effectiveness and efficiency for all organizations concerned, transfer must be predicated on a thorough understanding of both the civilian training requirements and the content of the DoD materials.

Similarly, even those instructional materials that better meet the needs of the civilian sector may need to be "de-greened" (i.e., modified to eliminate references to the military environment that are inappropriate to or detract from the effectiveness of training in the civilian sector). This can only be determined on a case-by-case basis, examining the specific civilian requirement and the content of the candidate DoD program.

In addition, many of the materials--particularly ICW materials--will need to be designed for other purposes and otherwise modified for use in civilian environments. Such modifications may include "de-greening" and reprogramming for compatibility with different software operating systems and delivery hardware. Such redesign may not

always be the most cost-effective means of meeting the civilian requirement, since these modifications may frequently approximate or even exceed the cost of developing new materials tailored to the specific civilian requirement.

In addition to the question of instructional content, one must also consider the legal ramifications of transferring DoD instructional materials to the civilian sector. One of the most obvious of these issues concerns copyright. The DoD does not hold the copyright to many of the current DoD instructional materials--and ICW programs and materials in particular. In such cases, the DoD does not have the legal right to transfer the product to any agency other than the one for which it was originally designed. In other cases, these materials may be transferable, but only at substantial additional cost to the outside user.

Another complicating factor is the issue of security review of the instructional materials. Obviously any materials that are classified or cannot pass the other DoD security review criteria are not candidates for transfer. In addition, as with the discussion of "de-greening," above, a review of the candidate material would have to be made to screen for any content that would have national security implications, since once the material is transferred to the civilian sector, there are no controls over its distribution.

Another interesting legal complication to the transfer of instructional materials is the issue of liability. For example, medical training programs such as those in CAMIS have already raised questions concerning the limits of the DoD's liability regarding potential health complications that could be attributed to the civilian use of DoD medical procedures.

Finally, there currently is great disparity among the types of hardware, software, and delivery systems that are available to play ICW programs. At this time, it cannot be assumed that a program that was developed to play on one system will automatically play on another without expensive modifications. As discussed in Section III, above, the DoD has an on-going initiative to rectify this problem for the military sector. However, not only is this initiative still in progress, but even when fully implemented it will not affect the same problem in the civilian sector. As a result, for many cases, the civilian recipient of the program will have to bear the cost of reprogramming the material where possible so that it is usable. This may often be more expensive than developing entirely new training materials tailored to specific civilian needs.

C. RESPONSIBILITIES AND RESOURCING

Despite the issues raised in the previous two subsections, the DoD recognizes that there may be training materials that can transferred to the civilian sector such that training value is not offset by incurred cost. Moreover, once the DITIS becomes fully operational, the DoD will be in a position to more efficiently identify ICW programs that may potentially meet civilian training requirements and whose transfer is not limited by the issues raised above.

However, not only must the potential impediments to transfer discussed above be resolved, but ambiguities in the allocation of responsibilities to affected agencies and the lack of sufficient resources must also be resolved before the transfer of DoD instructional materials can become a pratical reality. These issues are discussed below.

Before further DoD actions are undertaken, there are many other issues that must be resolved to effect efficient and effective transfer of materials. These activities concern the resourcing, roles, responsibilities, and inter-relationships of the involved agencies:

- Determination of specific civilian requirements;
- Redesign and modification of instructional content;
- Reprogramming to meet recipient's delivery system needs;
- Identifying and marketing to potential civilian users;
- Production, warehousing, and distribution of materials.

These functions are especially costly and complex when they involve technology-based instructional materials. Responsibilities for the above functions must be clearly defined and appropriately allocated to the receiving organizations, including the Departments of Labor, Commerce, and Education and private industry.

Finally, the issues discussed in this section must be adequately resourced in terms of time, money, and personnel. It is only in this way that the goals and objectives of technology transfer can be satisfied.

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